

Tracheal System in the Larvae of the Bruchidae (Coleoptera: Bruchidae)

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Abstract: The tracheal system of the larvae of eight species of the family Bruchidae were studied with reference to its taxonomic importance. Differences in the arrangement of the tracheal branches in the anterior region of the body and in the number of the air sacs at the subfamily level were observed. The species studied were *Callosobruchus maculatus* (F.), *Callosobruchus analis* (F.), *Bruchidius saundersi* (Jek.), *Bruchidius albizziae* Arora, *Bruchus pisorum* L., *Zabrotes subfasciatus* (Boh.), *Caryedon gonagra* (F.) and *Caryedon languidus* Gyll.

INTRODUCTION

The tracheal system in the larvae of the Bruchidae is an important character for separation of the larvae at the subfamily level.

Zacher (1930), Mukerji (1939), de Luca (1959) and Pajni (1968) described the tracheal system in *Zabrotes subfasciatus* (Boh.), *Bruchus quadrimaculatus* F., *Bruchidius trifolii* Motsch and *Callosobruchus maculatus* (F.) respectively without realizing its taxonomic significance. The present study is concerned with a comparative account of the tracheal system and an evaluation of its taxonomic significance in the last instar larvae. Of eight species examined five are referable to the subfamily Bruchinae (two each from the genera *Callosobruchus* and *Bruchidius* and one from the genus *Bruchus*), one to the subfamily Amblycerinae (represented by the genus *Zabrotes*), and two to the subfamily Pachymerinae (represented by the genus *Caryedon*).

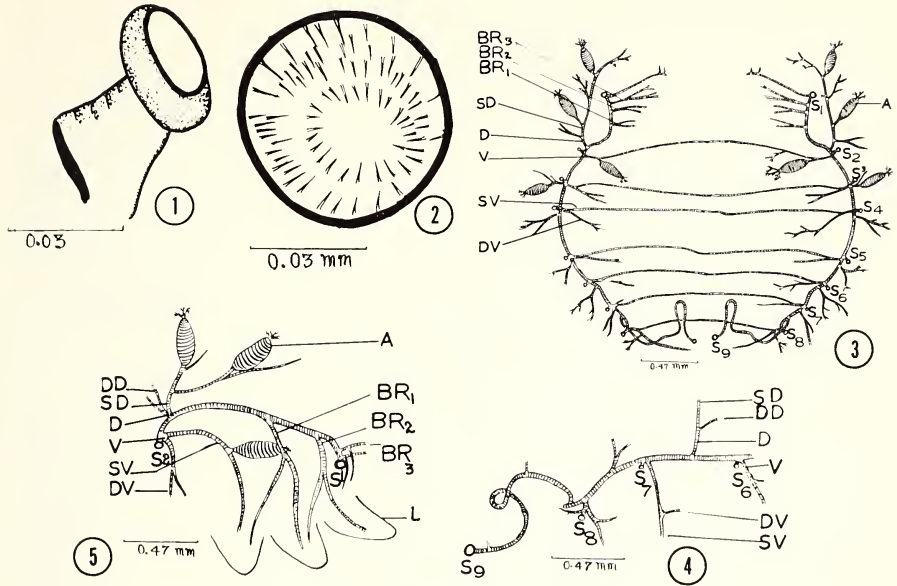
The larvae were collected during U.S. PL.480 Scheme on Bruchidae under Principal Investigatorship of Prof. G. L. Arora, Panjab University, Chandigarh (India).

OBSERVATION AND DISCUSSION

A peripneustic type of hemipneustic respiratory system is present in all the species studied.

Nine pairs of spiracles are located symmetrically on either side of the body. The first pair of spiracles is in the mesothorax posterior to the intersegmental

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ABBREVIATIONS

A = Air-sac; BR₁ = First thoracic tracheal branch; BR₂ = Second thoracic tracheal branch; BR₃ = Third thoracic tracheal branch; D = Dorsolateral branch of longitudinal trunk; DB = Additional dorsal branch; DD = Deep seated branch of dorsolateral branch (D); DV = Deep seated branch of ventrolateral branch (V); S₁ = Meso-thoracic spiracle; S₂-S₉ = Eight abdominal spiracles; SD = Superficial branch of dorsolateral branch (D); SV = Superficial branch of ventrolateral branch (V); V = Ventrolateral branch of longitudinal trunk.

FIG. 1. Spiracle of *Callosobruchus maculatus*.

FIG. 2. Surface view of *Callosobruchus maculatus* spiracle.

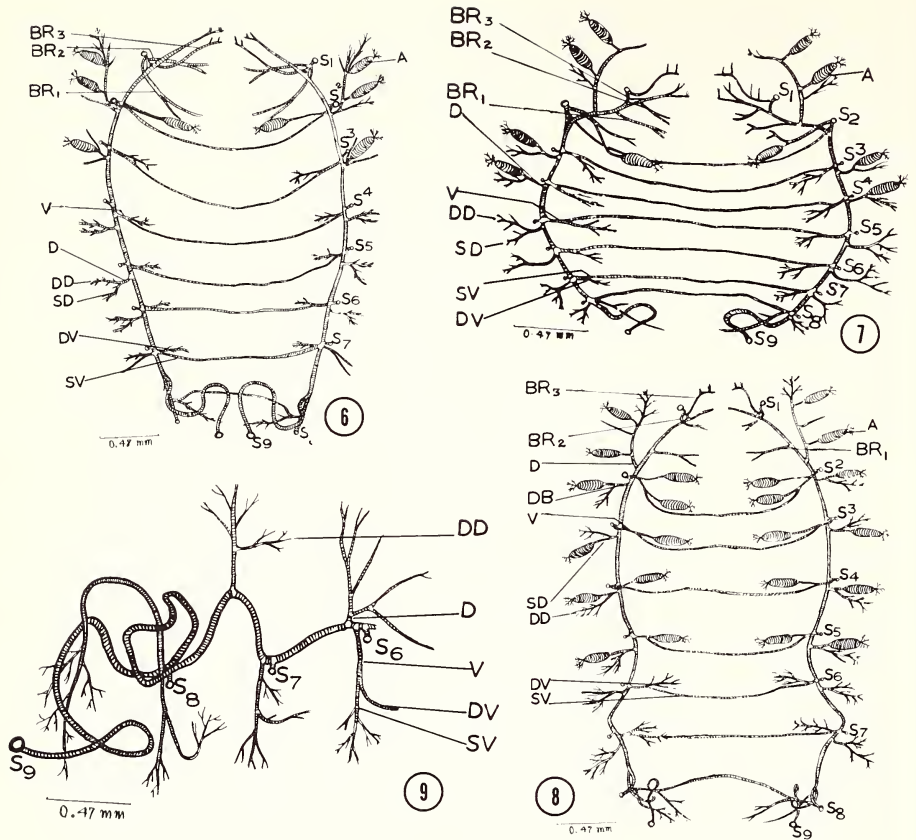
FIG. 3. Tracheal system of *Callosobruchus maculatus*.

FIG. 4. Lateral view of the posterior part of the tracheal system of *Callosobruchus maculatus*.

FIG. 5. Lateral view of the tracheal system in the anterior part of the body of *Callosobruchus maculatus*.

line dividing the prothorax and the mesothorax. The remaining eight pairs are on the first eight abdominal segments, a pair on each segment. Each spiracle (Fig. 1) is annular, uniforous and atriate with an internal closing apparatus. The inner wall of the atrium bears numerous small cuticular hairs (Fig. 2).

Zacher (1930), Mukerji (1939), de Luca (1959) and Pajni (1968) reported nine pairs of spiracles, one thoracic and eight abdominal, in *Zabrotes subfasciatus*, *Bruchus quadrimaculatus*, *Bruchidius trifollii* and *Callosobruchus maculatus* respectively. According to Zacher (1930), Mukerji (1939) and Pajni (1968) the thoracic spiracle is present on the intersegmental line between the pro- and the meso-thorax however, de Luca (1959) mentioned that this

FIG. 6. Tracheal system of *Bruchus pisorum*.FIG. 7. Tracheal system of *Zabrotes subfasciatus*.FIG. 8. Tracheal system of *Caryedon languidus*.FIG. 9. Lateral view of the tracheal system in the posterior region of the body of *Caryedon gonagra*.

spiracle is on the mesothorax which is in accordance with the present investigation. Pajni (1968) stated that in addition to this thoracic spiracle, a closed spiracle is also found on the mesothorax. I have not observed such a spiracle in any of the species studied.

A pair of lateral longitudinal tracheal trunks runs on either side of the body from the eighth abdominal segment to the mesothoracic segment. Each of the first seven abdominal segments is supplied with a pair of dorsolateral and a pair of ventrolateral tracheal branches, but in *Caryedon* (Fig. 8) there is an additional dorsal branch arising behind the first abdominal spiracular trunk. It supplies the anterior part of the alimentary canal.

In *Callosobruchus* (Fig. 3), *Bruchidius*, *Zabrotes* (Fig. 7) and *Caryedon* (Fig. 8) the dorsolateral branch of the first abdominal segment originates from the lateral longitudinal trunk in front of the first abdominal spiracular trunk, whereas in *Bruchus* (Fig. 6) it originates behind the first abdominal spiracular trunk. The dorsolateral branch in each of the segments from second to sixth arises behind the spiracular trunk of the same segment in all the species. It branches into a deep-seated and a superficial branch in each segment, both supplying the dorsal parts of the body.

The ventrolateral branch of the first abdominal segment always originates from the spiracular trunk whereas in the segments from second to sixth it arises from the longitudinal tracheal trunk. The ventrolateral branch supplies the ventral and the lateral parts of the body and, like the dorsolateral branch, divides into a deep-seated and a superficial branch. The latter forms the ventral transverse commissure in each of the first seven segments.

The spiracular trunk of the eighth abdominal segment is extremely long and coiled in all the species (Figs. 4, 9). The last two segments receive the tracheal supply from the dorsolateral and the ventrolateral branches of the 7th segment.

The thorax is supplied with three tracheal branches on either side. These branches arise either from the lateral longitudinal tracheal trunk or from the mesothoracic spiracular trunk or from both. This character can be utilized in separating the genera. In *Callosobruchus* (Fig. 3), *Zabrotes* (Fig. 7), and *Bruchidius* all the three branches arise from the lateral longitudinal trunk between the mesothoracic and the first abdominal spiracles, whereas in *Caryedon* (Fig. 8) the first branch arises from the lateral longitudinal trunk and the remaining two branches arise from the mesothoracic spiracular trunk. In *Bruchus* (Fig. 6), all three branches originate from the meso-thoracic spiracular trunk. Regardless of their origin, these branches supply the same respective parts in all the species. For example, the first thoracic branch bifurcates into an anterior branch entering the mesothoracic leg and a posterior branch goes to the metathoracic leg. The second branch, like the first branch, divides into an anterior branch going to the prothoracic leg and a posterior branch entering the mesothoracic leg. The third branch also bifurcates into an anterior and a posterior branch. The anterior branch after sending the tracheae to the prothorax enters the head, whereas the posterior branch supplies the mesothorax.

The thorax also receives the tracheae from the dorsolateral and the ventrolateral branches of the first abdominal segment. The superficial branch of the dorsolateral branch supplies the tracheae to the dorsal region in the mesothorax, whereas its deep-seated branch after entering the thorax bears a pair of air sacs. Similarly, the superficial and the deep-seated branches of the ventrolateral branch supply the tracheae to the metathoracic legs and the metathorax.

A pair of tracheal branches on either side enters the head from the thorax.

Of these the dorsal branch sends the tracheols to the antennae, the mandibles and the brain whereas the ventral branch supplies the labium and the maxillae. The dorsal branches of the two sides unite to form a dorsal head commissure.

Air sacs are present in every species. They are distensible and when inflated are seen as glistening white oval vesicles. From the apex of each air sac a tracheal branch arises which immediately divides into finer branches that enter the fat bodies. Air sacs reduce the compressibility of the body and increase the capacity for storing air. The number of sacs differ in the different subfamilies and is significant in classification at the subfamily level. There are four pairs of air sacs in Bruchinae (Figs. 3, 6), five pairs in Amblycerinae (Fig. 7) and eleven pairs in Pachymerinae (Fig. 8). They are borne on the dorsolateral and the ventrolateral branches of the first four abdominal segments.

Zacher (1930) mentioned five pairs of air sacs in *Zabrotes subfasciatus*. Mukerji (1939) and de Luca (1959) reported four pairs in *Bruchus quadrimaculatus* and *Bruchidius trifolii* respectively. These investigations confirm that the number of air sacs in a subfamily is fixed.

The arrangement of the air sacs on either side of the body is as follows:

1. The dorsolateral branch of the first abdominal segment bears a pair of air sacs located in the pro- and the meso-thorax, whereas the ventrolateral branch of the same segment carries an air sac lying in the mesothorax in all the species. In *Caryedon* (Fig. 8) the additional dorsal branch also bears an air sac.
2. The dorsolateral branch of the second abdominal segment bears an air sac located in the same segment in all the species. The ventrolateral branch of the same segment bears no air sac in *Callosobruchus* (Fig. 3), *Bruchus* (Fig. 6), *Zabrotes* (Fig. 7) and *Bruchidius* whereas an air sac is present in *Caryedon* (Fig. 8).
3. The dorsolateral branch of the third abdominal segment bears no air sac in *Callosobruchus*, *Bruchus* (Fig. 6), and *Bruchidius* whereas it carries an air sac in *Zabrotes* (Fig. 7) and *Caryedon* (Fig. 8). The ventrolateral branch of the same segment is without any air sac except in *Caryedon* in which there is an air sac on this branch.
4. The dorsolateral and the ventrolateral branches of the fourth abdominal segment are without air sacs in *Callosobruchus*, *Bruchus* (Fig. 6), *Zabrotes* (Fig. 7) and *Bruchidius* whereas an air sac is present on each of the above mentioned branches in *Caryedon* (Fig. 8).

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Comparative Virology Conference

The 2nd International Conference on Comparative Virology, sponsored by the University of Montreal and McGill University is planned for Sept. 3-5, 1973 at Mt. Gabriel, Que., Canada.

Prof. Edouard Kurstak (U. Montreal) and Dr. Karl Maramorosch (Boyce Thompson Institute) will serve as joint chairmen, assisted by Dr. André Lwoff (Cancer Institute, Villejuif, France) and Dr. Joseph L. Melnick (Baylor Univ., Houston, Texas).

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